Tecnews

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I.F. "SKIRT" SELECTIVITY

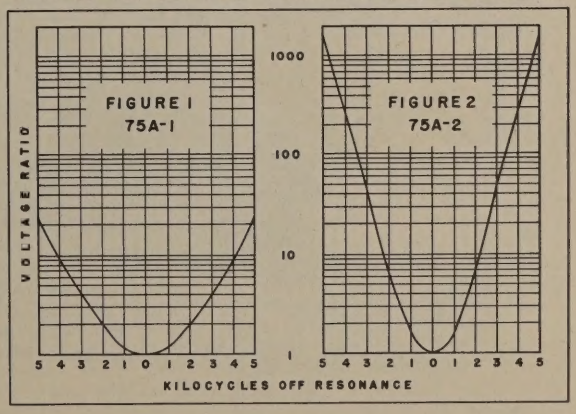
by Clayton F. Bane, W6WB

Since improved I.F. selectivity seems to be the keynote in all of the latest communication receivers, it would seem timely to discuss this subject in conjunction with a brief explanation of spurious responses that can occur in any receiver.

While we personally feel that too much stress has been put on I.F. selectivity at or near the actual I.F. pass band region, comment on the subject may serve to point up some useful facts. It is apparent that if a modulated signal is to be received, the I.F. must have sufficient width to insure relatively unattenuated response to the wanted sideband frequencies. Conventionally, the I.F. pass-band width is established as that existing between the two frequencies, (either side of the center or mid-band frequency) where the response will have dropped by a 2:1, (power) ratio or 3 db. This then gives rise to the widely used term, 'Band-width between the half-power points'. Practically, the 2:1 drop is considered negligible and the response is regarded as though the I.F. curve were flat-topped between the two frequency limits. Let's consider this in terms of sideband frequency response.

For conventional double-sideband AM reception, the I.F. should have a band-width across the half-power points equal to twice the frequency of the highest modulation audio frequency contained in the received modulation envelope. This being so, it is easy to see that, as the pass-band width of the I.F. channel is decreased, more and more of the higher audio frequencies will be attenuated. If, in a purely theoretical case, the shoulders of the I.F. curve were to drop to infinity directly beyond the half-power points, a relatively wide total band width of 6 kc would make a extended audio range modulated signal sound like it was being heard over a wire telephone circuit. This statement assumes that the carrier would be centered within the 6 kc total pass band to provide a flat 3 kc response on either side. Now then, a practical case. Fig.1 shows the top portion of the overall selectivity curve of the Collins 75A1 receiver. It will be noted that the nose of this curve is reasonably sharp since the width across the half power points is only about 4 kc. Nonetheless, this particular receiver does an excellent job of reproducing a voice signal with extended audio range. The reason for this can be found in the shape of the curve past the half power points. In other words, while the higher audio frequencies are definitely attenuated, the slope of the curve is such that they still produce a substantial output voltage. As a matter of comparison, a portion of the overall selectivity curve of the 75A2 is shown in Fig.2. (This curve is with the I.F. circuits tuned for phone operation. The C.W. alignment produces a much sharper nose.) In comparing the curves, note that in Fig.1 a signal 5 kc removed from the center of the pass-band is down by approximately 30 db, whereas in Fig.2 a signal removed by the same amount is down nearly 65 db. This increased skirt selectivity is obviously of material help in reducing adjacent channel interference and fortunately is a definite trend in three of the most modern receivers of different manufacture.

It is significant to note that the skirt selectivity is determined by the number of tuned circuits used in the I.F. strip. For example, the use of a crystal filter in the sharp position can reduce the band width across the half-power points to a few hundred cycles to provide the ultimate in adjacent channel selectivity but the rejection to signals far removed from resonance will not be improved in the slightest. The shape of the curve near its nose can be radically altered ---from needle point to a completely flat top but the only thing that will effect the shoulders of the curve is additional tuned circuits

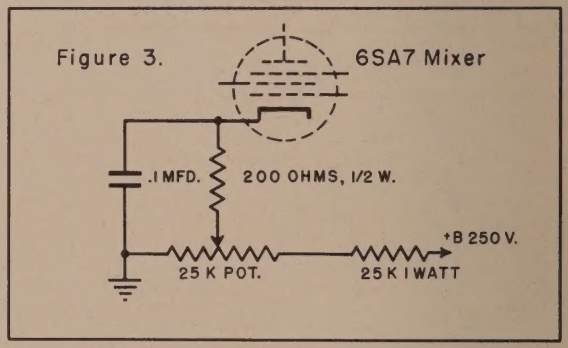


One might well wonder about all the concern about signals removed, let us say, 200 kc from resonance. It is true that if these are distant signals and are weak they are of little concern to us. But what about signals from a local station perhaps not over three or four blocks away?

In a typical case, a kw station two blocks away will drive my 6SA7 mixer into grid current. Since this mixer has over 2 volts of negative bias, we can assume that the signal from the RF stage ahead of this mixer is at least equal to this value and by dividing by the estimated gain of the RF stage, (possibly 15) we arrive at an input signal to the RF stage of approximately 100,000 microvolts!! With this tremendous signal there is little use in talking about overload in the I.F. stages...the damage will already have been done by the fact that grid current in the mixer will produce distortion products which will be passed on to the I.F. stages to appear as spurious signals all over the band. Variable bias on the mixer stage can be very helpful since it is possible to adjust this bias below the point of grid current while still maintaining R.F. and I.F. stage gains to reasonable values. A simple circuit for this control is shown in Fig.3.

Assuming that front end overloading can be avoided, (possibly in the manner suggested) what bearing does I.F. selectivity have on rejection of such strong signals? As mentioned an important feature of all I.F. stages is the amount of rejection they offer to signals far removed from their normal pass-band. In other words, signals out on the I.F. skirts. It is characteristic of I.F. selectivity curves that rejection increases rather sharply just beyond resonance and then tapers off very slowly. Thus the I.F. might offer 80 db rejection to a signal 100 kc removed, yet only 85 db to a signal 200 kc away. Added rejection to signals off on the skirts, (provided by additional tuned circuits in the I.F.) will serve to prevent overall dropping in signal level when a strong local is operating and when A.V.C. is being used. Mention of A.V.C. action brings up still another point.

It has become almost universal practice when receiving phone signals, to use the 'S' meter to establish correct tuning. Maximum meter reading in conjunction with a slightly rounded nose curve such as that shown in Fig.2 will mean that the carrier of the phone signal is accurately centered within the I.F. pass band....this in turn providing equal sideband response on either side of the center frequency. There is nothing wrong with this procedure as such but there are other ways of tuning in a signal that may be far more advantageous under QRM conditions. CW men have long tuned their receivers on a single rather than double sideband basis by shifting their BFO over so that it falls on one slope or the other of the I.F. curve. There is no reason why a phone signal cannot be tuned in a similiar manner, particularly on one of the new receivers having steep I.F. curves. If the incoming signal is tuned so as to fall just slightly down on one slope of the I.F. curve, one sideband will be fully within the I.F. pass band, the other down on the steep slope of the curve. Obviously this latter sideband will be attenuated. There is no need for reproducing both sidebands... the classic remark applies, '....both sidebands are saying the same thing.' Admittedly, this procedure is a crude attempt at single-sideband reception of a double sideband signal but it can and does result in a substantial reduction of adjacent sideband and heterodyne interference. The main thing is not to become a slave to the S meter. Try turning off the AVC and tune the receiver using the manual gain control. When you do this you will aurally tune the desired signal for maximum intelligibility in the presence of QRM. It may be quite surprising to make the proper set in this manner and then turn on the AVC and S meter. You may well have to retune for maximum S meter indicating that the cleanest signal occured off to one side instead of in the center of the pass band. Also the use of manual gain usually results in a far better ratio of signal to background noise.



Let it be clearly understood that when the signal is tuned off to one side so that the carrier drops perhaps 6 db, you have altered the carrier-to-sideband relation and loss of audio will be a resultant. In a good single sideband receiver, (for the reception of double sideband signals) the I.F. pass-pand is flat-topped and the incoming carrier is balanced out and a fixed, 'exalted' carrier is substituted. The strength of this exalted carrier is always such as to be many times that of the strongest carrier to be received. Notwithstanding, there are always instances on crowded amateur phone bands where ability to understand what the other fellow is saying is far more important than to have him produce twice as much audio and be unintelligible in the presence of heterodyne and adjacent sideband QRM. Turn off the AVC, disable the S meter and give it a try. You may be surprised.

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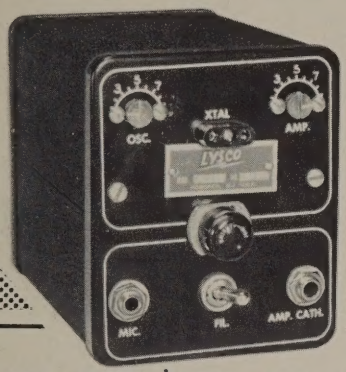

MOD.	BAND	TUBES	MOD.	BAND	TUBES
A-114	20 M	3-6AQ5	A-129	10 M	3-6AQ5
A-140*	160 M	3-6AQ5	B-129	10 M	3-6V6GT
B-114	20 M	36V6GT	A-175	75 M	3-6AQ5
B-140*	160 M	3-6V6GT	B-175	75 M	3-6V6GT

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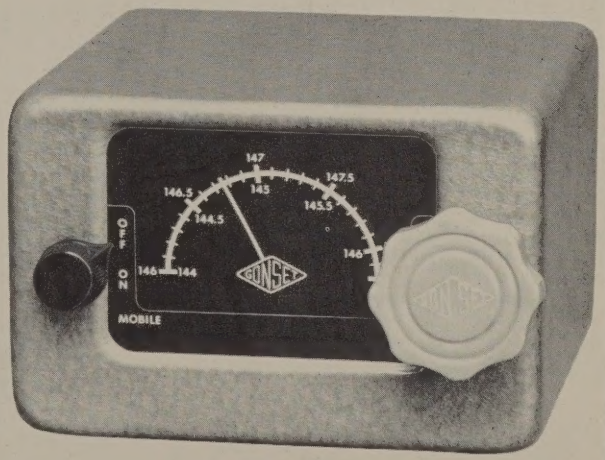

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Excellent VR oscillator. Highly stable under voltage changes and mechanical vibration.

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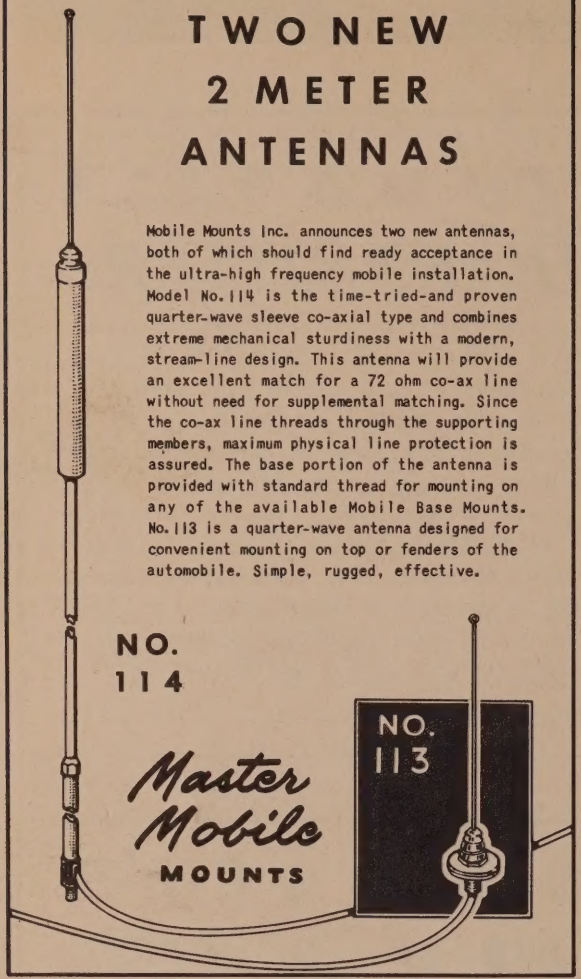
TWO NEW 2 METER ANTENNAS



Mobile Mounts Inc. announces two new antennas, both of which should find ready acceptance in the ultra-high frequency mobile installation. Model No. 114 is the time-tried-and proven quarter-wave sleeve co-axial type and combines extreme mechanical sturdiness with a modern, stream-line design. This antenna will provide an excellent match for a 72 ohm co-ax line without need for supplemental matching. Since the co-ax line threads through the supporting members, maximum physical line protection is assured. The base portion of the antenna is provided with standard thread for mounting on any of the available Mobile Base Mounts. No. 113 is a quarter-wave antenna designed for convenient mounting on top or fenders of the automobile. Simple, rugged, effective.

NO. 114

Master Mobile MOUNTS

NEW!

HRO 50-1

Here is National's answer to todays crowded bands....the new HRO-50-1. This new receiver has three stages of I.F. and 12 permeability-tuned I.F. circuits. (4 per stage) These in addition to the crystal filter. The HRO-50-1 attains a degree of selectivity on the "skirts" seldom found in any general communications receiver without excessive narrowing of "nose" selectivity. All of the excellent features of the widely known HRO-50 are retained in this effective new communications receiver.

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